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CITY OF BOSTON
PUBLIC WORKS DEPARTMENT

**NEW RATES
FOR THE
WATER DIVISION**

March 1971

CAMP DRESSER & McKEE Inc.

CAMP DRESSER & MCKEE

**CITY OF BOSTON, MASSACHUSETTS
PUBLIC WORKS DEPARTMENT**

NEW RATES FOR THE WATER DIVISION



MARCH 1971

CAMP DRESSER & MCKEE INC.

Consulting Engineers

Boston, Massachusetts

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DONALD E. CULLIVAN
Senior Vice President

March 29, 1971

Mr. Joseph F. Casazza
Commissioner of Public Works
City of Boston
One City Hall Square
Boston, Massachusetts

New Rates for the Water Division

Dear Mr. Casazza:

In compliance with our contract with the City of Boston, dated December 30, 1970, we have projected Water Division costs and estimated revenue requirements over the next five years. A recommended water rate schedule is presented that is expected to meet all anticipated Water Division expenditures within this five-year period. Additional recommendations are made throughout the report that emphasize areas which will require new or increased appropriations during the next few years. A summary of this report follows.

Water Use

Water use was projected on the assumption that the total population served would remain relatively constant but per capita water use would increase at a rate of about two percent per year. It was also assumed that the ratio of water billed to water purchased from the MDC would remain relatively constant at the present level of about 55 percent.

Costs

Water Division costs can be expected to increase substantially in the coming years. The principal reasons for this increase are a probable increase in MDC rates, higher salaries from collective bargaining, rising costs for materials, equipment and contractual services, and an accelerated capital improvement program.

Revenue requirements were projected by reviewing past annual Water Division expenditures and charges from other municipal divisions. Projections were based on the current trend of wage and material price increases. Additional studies included anticipated indebtedness through the issuance of bonds and probable future MDC assessments for water delivered to Boston's distribution system. The total estimated expenditure for the next five years was then increased by five percent to account for billings sent out that are not collected.

The average expenditures during the five-year period 1972 through 1976 is estimated to be \$17,800,000 per year. This estimated expenditure represents an increase of about 67 percent over the average total cost of \$10,700,000 per year for the past four years (1967 - 1970).

Revenue

For the last three years Water Division expenditures have exceeded revenue and the resultant deficit has been paid out of City taxes. In order to place the Water Division back on a self-sustaining basis a new water rate schedule is proposed. This new rate was prepared by studying the various revenue sources. As approximately 98.5 percent of water revenue is obtained from metered accounts, these water use charges will have to provide most of the required revenue.

A computer program was prepared in order to develop a rate schedule which would apportion the revenue requirements of the next five years to the various categories of water use. The present three block rate structure was maintained but the suggested schedule of water rates will result in a small reduction in the amount of water allowed by the minimum rate for each meter size.

The proposed rate schedule represents an increase of 50 percent in the minimum rate for each meter size and an increase of about 67 percent in metered water use. The present and proposed rate schedules are shown in the following tables:

MINIMUM CHARGES, PER QUARTER

Meter Size (in)	Present Schedule		Proposed Schedule	
	Water Allowance	Minimum Charge	Water Allowance	Minimum Charge
5/8, 3/4	1,666 cu ft	\$5.00	1,500 cu ft	\$7.50
1	4,166	12.50	3,750	18.75
1 1/2	6,250	18.75	5,600	28.00
2	12,833	37.50	11,250	56.25
3	26,000	75.00	23,048	112.50
4 and larger	46,000	125.00	41,341	187.50

WATER USE CHARGES, PER QUARTER

Cost of Water Per 1,000 Cu Ft.

Block No.	Quantity	Present Schedule	Proposed Schedule
1	First 20,000 cu ft	\$3.00	\$5.00
2	Next 980,000 cu ft	2.50	4.10
3	Over 1,000,000 cu ft	1.75	3.00

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Mr. Joseph F. Casazza - 3
March 29, 1971

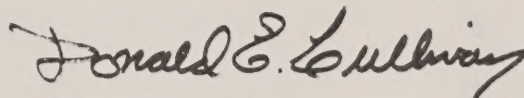
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An important factor to be stressed is that the proposed rate schedule, while developing sufficient revenue to meet the estimated 67 percent increase in costs over the next five years, will result in an increase of only 50 percent to many residential customers. Most of these people, who represent about 40 percent of all the Water Division's accounts, will continue to find the minimum water allowance adequate for the largest portion of their needs.

Acknowledgements

We wish to acknowledge with thanks the cooperation and assistance received from the staff of the many municipal departments contacted. We are particularly indebted to Mr. John P. Sullivan, Division Engineer, for his help and comments during the preparation of this report.

Very truly yours,
CAMP DRESSER & McKEE Inc.



Donald E. Sullivan
Senior Vice President

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CITY OF BOSTON, MASSACHUSETTS
PUBLIC WORKS DEPARTMENT
NEW RATES FOR THE WATER DIVISION
INTRODUCTION

General

It has always been the policy of the City of Boston to have the Water Division operate as a self-sustaining department so that annual expenditures would be met by water revenue. Since 1968, spiraling city costs have exceeded water revenue, resulting in large deficits that are being borne by the City tax structure. Exhibit 1 shows the increasing gap between revenue and expenses over the past several years. These deficits are attributable principally to mandatory increases in wages and benefits of City employees and to the rising costs of equipment, supplies and construction. Recent studies recommend that the Water Division improve and expand Boston's distribution system, one of the oldest in the country. Implementation of these recommendations will require heavy annual capital financing. It is also expected that the water division of the Metropolitan District Commission (MDC), which is currently being supported through deficit financing, will seek to raise its rates. If approved, this rate increase probably would become effective January 1, 1972.

As annual water revenue of the Water Division is now more than \$2,000,000 below expenses, it is imperative that water rates and other charges be raised. This increase also should provide for greater capital improvements and the probable MDC water rate increase. For this reason, the Commissioner of Public Works, Mr. Joseph F. Casazza, has instructed the Water Division to review and adjust the water rate structure. The consulting engineering firm of Camp Dresser & McKee, who prepared an earlier report on water rates for Boston in March, 1961, has been engaged by the City of Boston to assist the Water Division in the preparation of new water rates.

Scope and Procedure

The scope of work provides for a new water rate schedule utilizing the present billing structure and water allowed as part of the minimum service charge, if still considered reasonable. The new rate schedule is to be projected for the next five years based on all anticipated expenditures, including existing debt obligations and capital outlays. Operational and statistical data were collected from past annual reports and through discussions held with personnel of the various City departments involved.

From 1967 through 1969 water use charges from metered rates accounted for about 98.5 percent of the annual Water Division revenue and these water use charges must be depended upon to provide the bulk of the increase in revenue. An equitable apportionment can be provided by pro-rating consumption by meter size and block rate. This was done through a computer program designed to scan actual individual city water billing during the four 1970 billing quarters. Required revenue was determined by analyzing all of the Water Division expenses and projecting them for the next five years. Miscellaneous estimated revenue, such as fire pipe charges, service connections, etc., were then subtracted. Break rates and minimum rates were selected for the computer program that best fit the remaining revenue requirements.

Previous Recommendations

Although the purpose of this report is to revise the existing schedule of rates based on the 1961 Camp Dresser & McKee water rate study, it may be well to repeat several recommendations of the earlier report most of which are still considered pertinent. Briefly those recommendations were:

1. Establish a program to eliminate leaks and under-registration of meters.
2. Initiate a thorough study of the entire distribution system, including a compilation of capital assets together with a schedule for replacement or repair.
3. Meter all water used by municipal agencies and other departments outside the Water Division and charge for this water.
4. Limit the use of water revenue to Water Division expenses and capital improvements.
5. Establish a capital improvement program and substantially increase the annual allowance for such improvements.

The Water Division has done much in these areas and are continuing their efforts as funds are made available. From 1960 through 1964, Pitometer Associates, specialists in water waste surveys, conducted an effective program in leak detection and location of faulty large meters, including those of the MDC. In 1966, through an interest free loan from the Federal Department of Housing and Urban Development, Charles A. Maguire and Associates made an engineering investigation on necessary improvements to the entire City water system. Less progress has been seen on the

installation of meters on municipal buildings although the Water Division now requires that meters be included in all new construction.

To date there remains no charge for water used by other municipal departments although the Water Division is charged for interdepartmental services. Surplus revenue is also still used to retire the City's general debt which has made it necessary for the Water Division to finance capital outlays through the issuance of bonds.

Many of these previous recommendations are repeated in this report as is the recommendation for greater emphasis on planning and scheduling of a capital improvement program. Although annual allowances for new construction and repair have markedly increased in the past 10 years the program has been seriously hampered by the lack of an adequate number of experienced engineers and inspectors to carry out the work.

WATER USE

Population

The City of Boston, like all large cities, is faced with a major change in population as the outflux to the suburbs continues. The present trend seems destined to continue for several more years. Estimates made in the early sixties failed to predict the magnitude of the decrease in the City's population. The present population of Boston is approximately 641,000. This is a decrease of 8.9 percent from the 1960 population of 698,000. The 1960 figure was 12.9 percent below the all-time high population of 801,000 recorded in 1950.

During the past 10 years, steps have been taken within the City to stem the flow of people to the suburbs. Large-scale urban renewal has been carried out within the City. At the present time the demolition phase has been completed for the most part and construction and rehabilitation is well under way. Over the next 10 years, this should make available some sixteen to eighteen thousand new housing units. This should tend to arrest the downward drop in population and stabilize it close to its present level.

Per Capita Consumption

Although the population has been dropping, the per capita water consumption has been increasing rapidly for the past several years such that total water use is increasing. This can be seen from the graph in Exhibit 2. With Boston's population in a state of flux, it was decided that it would be preferable to use the past record of metered water as the principal indicator for future water consumption.

Over the past 10 years the metered consumption of Boston consumers has risen from 26 billion gallons in 1960 to almost 29 billion in 1970. This is an increase of 7,400,000 gallons per day. The per capita consumption has increased from 166 gallons per person per day in 1960 to 222 gallons per person per day in 1970, or about a 3 percent increase per year. For the next five years a relatively static population has been assumed with a per capita consumption increase of about 2 percent per year. This increase is approximately equal to the national average and results in an 11 percent increase in total consumption by 1976.

Unbilled Water

The lower line of Exhibit 2 indicates the water that is recorded on customers' meters. The upper line is the water that is purchased from the MDC at the 28 metered connections which Boston maintains with the MDC. The space between the two lines represents the water that is not billed each year.

In 1970 the City of Boston purchased a total of 51.7 billion gallons of water from the MDC. The amount of water that passed through the meters of the consumers within the City was only 28.7 billion gallons. This means that 23.0 billion gallons was lost to the City for revenue purposes, or approximately 45 percent of all water purchased by the City. The purchase price for this unbilled water was in excess of \$2,760,000. If all of this water could have been billed, it would have brought an additional \$7,650,000 into the City treasury. In recent years the percentage of unbilled water has been steadily increasing.

Unbilled water falls into several categories. One is under-registration of meters. It is very difficult to estimate how much water is being used and revenue being lost to the City from this cause. A systematic program should be established for periodically testing all meters, with larger meters being tested more frequently.

Unmetered accounts are another source of unbilled water. Very few facilities that are operated by the City are metered and none are billed for water used. This is a poor policy for several reasons. If the Water Division is to be a self-sufficient organization, it should not be forced to subsidize other City departments, especially when the Water Division is charged by other departments for services performed for the Water Division. A City department should not be treated differently than any other customer. The metering and billing of these departments would help to reduce unnecessary waste. Even if the City decides not to bill these departments, they still should be metered in order to assist the Water Division in accounting for the water purchased from the MDC.

The fighting of fires requires large amounts of water for relatively short periods-water which is never recorded on a meter. Provision of water for fire fighting purposes is one of the basic functions of the Water Division. The total amount of water used to fight fires in the City is a very small percentage, however, of the unbilled water.

One of the largest portions of unbilled water apparently is lost to the City through leaks. The Water Division is well aware of this situation; but with the limited personnel available, it is a tremendous task just to repair the leaks that are brought to the Division's attention. Pitometer Associates of New York worked successfully with the Division in the location of leaks in the early sixties. It is recommended that a similar type of leak detection and repair campaign again be undertaken. Recognizing the limitations of the Water Division repair capabilities, it is recommended that the actual repair work be carried out on a contractual basis. The cost of such a program will be more than offset by the savings made in water not wasted.

Summary of Water Use

While the recommendations above should result in a reduction of unbilled water, it may not be possible to implement them to the extent required to reduce significantly the gap between water purchased from the MDC and water sold to consumers. Some minor improvement has been assumed, however, such that the present difference of 23 billion gallons is not expected to become greater. Maintaining this difference is equivalent to increasing the water sold to consumers from 55 to 58 percent of the water purchased from the MDC.

Based on a static population, a two percent per year increase in per capita consumption and the conditions stated above, the total water sold to consumers is estimated to increase from 29.3 billion gallons in 1971 to 32.3 billion gallons in 1976. The water expected to be purchased from the MDC is estimated to increase from 52.3 billion gallons in 1971 to 55.3 billion gallons in 1976. The annual estimates are shown in Exhibit 2.

REVENUE REQUIREMENTS

General

Although there has not been a Boston water rate increase since Camp Dresser & McKee's report in 1961, Water Division expenditures did not exceed annual revenue until 1968. The last three years, however, have resulted in sharp increases in costs. These increases produced an excess of expenditures over revenue of about 7 percent in 1968 and about 18 percent in both 1969 and 1970. The 1971 Water Division

expenditures, although reflecting the general City of Boston's austerity program, very likely will exceed revenue by 20 percent. The trend of the last few years in wages and supplies amounts to about a 7 percent annual increase in wages and a 10 percent increase in equipment and supplies. This trend is expected to continue and these figures were used in conjunction with the past 5 year average increases whenever straight line projections appeared unrealistic.

Metropolitan District Commission Charges

Chapter 723 of the Acts of 1962 permitted the MDC to increase the rate of assessment of the member cities and towns to \$120 per million gallons. The assessments were to be computed from the annual quantity of water delivered beginning January 1, 1963, and payable on November 20 of each year. In addition, Section 7 of these Acts requires the State Treasurer to draft legislation to raise the annual rate by \$5 whenever the bonds issued exceeded the amount of the principal payments in the prior fiscal year on bonds issued for construction of the water system. In 1969 bonds issued to cover the 1968 deficit exceeded redemption of construction bonds by \$163,000 and, consequently, House Bill 4549 was filed with the General Court, which would have increased the water rate from \$120 to \$125 per million gallons. This bill was approved by the House Ways and Means Committee, but no action was taken by the Senate.

Similar legislation could have been filed the following year as the 1969 fiscal year deficit again exceeded redemption of construction loans. However, two bills have been filed this year for consideration by the 1971 session of the legislature. These are House Bills H-2954 and H-4944. Both bills provide for the discontinuance of deficit financing and a return to a pay-as-you-go system.

The water development loan devised to finance bonds over an extended period now accounts for about 50 percent of the bonded indebtedness of the district. As a point of interest, had the member communities been assessed on a pay-as-you-go basis, the MDC annual requirements in 1969 would have been only \$103 per million gallons. Although there appears to be general agreement in initiating a pay-as-you-go system, there may be considerable opposition to raising rates to include early retirement of the MDC debt.

A hearing was held by the MDC on January 28, 1971, regarding House Bill H-4944 entitled, "Special Report of the MDC Relative to Water Rates." This report recommends a rate increase to \$160 per million gallons with the establishment of a water use reserve fund to balance future excesses or deficits. An additional provision is proposed to allow for \$5 annual incremental increases to avoid long-term financing of

future deficits. No objection to the rate increase was advanced at the hearing by representatives of several of the member cities and towns, but this is not necessarily indicative of the majority.

Exhibit 3 is a graph of past water costs and water rates charged by the MDC. The proposed water rate increase to \$160 per million gallons will be adequate to meet annual costs for a year or two. However, operating and maintenance costs probably will continue to rise yearly and large new construction works will have to be financed to meet future expected water demands.

Based on estimated future MDC costs, the rate charged by MDC is expected to increase from \$160 per million gallons in 1972 to \$170 in 1976. The estimated annual rates are shown in Exhibit 3.

The estimated total cost of purchasing water from the MDC is determined by applying the annual rates of Exhibit 3 to the annual amounts of water to be purchased, as presented in Exhibit 2.

Interdepartmental Charges

The largest interdepartmental charges come from the other divisions of the Public Works Department. These include engineering and administration, plant and equipment, maintenance and street repairs. Annual charges have varied considerably, depending on the quantity of equipment purchased in any one year. From 1962 through 1970 the average annual expenditure has been about \$935,000 per year and about \$1,000,000 per year for the last three years. Assuming a 7 percent annual increase for salaries and supplies, the annual charge for these Public Works interdepartmental services is estimated to average about \$1,300,000 for the next five years. In continuance of an earlier comment, it is noted that although the Highway Division charges for repaving, water is supplied to them at no charge.

Assistance in the billing and collection of water receipts is given through the Data Processing Unit and Collecting Division. Data processing, among other services, records all service connections and bills the customer quarterly or semi-annually as required. Although it is estimated that the Water Division only accounts for about 17 percent of data processing time, they have been charged for 67 percent of this department's expenditures since 1968. Since its inception in 1963, the Data Processing Unit's annual charge to the Water Division has risen by almost 800 percent. The principal reason given for the heavy participation by the Water Division is because its deficits of the past three years have been paid by the City tax rate. A more equitable allowance presumably will be made when deficits are no longer incurred. As a

conservative approach, however, a continuing 67 percent charge has been assumed which will require \$700,000 per year for the next five years. This figure is based on the 1971 allocation of Data Processing costs to the Water Division with 7 percent annual increases for personnel services and pensions and a 10 percent annual increase in supplies. Contractual services, current charges and equipment were assumed to remain at 1971 levels.

The Collecting Division has also shown a steep rise in operating expenses since 1966 largely due to wages and pensions. The 1970 charge was \$42,000 below that of 1969 because pension payments included in the total charge are now incorporated with the Water Division's retirement plan. The past five-year trend has been close to an annual 7 percent increase for charges from this Division. Projecting, this trend will require an average of \$357,000 per year for the next five years.

Water Services

Water service expenditures account for all Water Division personnel costs, equipment and supplies, maintenance yards throughout the city, structures, utilities, and contractual services. In this report it has not been possible to make a detailed analysis of all divisional expenses nor is it appropriate at this time as City planning for new structures, equipment and additional personnel would make such a study meaningless. It will suffice to refer to the major groups and anticipate their requirements for the next five years.

Personnel Services have risen from \$1,832,000 in 1961 to the 1971 appropriation of \$2,957,929, or 62 percent over the last ten years. This increase is even more significant when considering that the total number of employees decreased from 333 to 277 during this period. City policy is to maintain existing manpower strengths at their present level and there is no reason to believe this policy will change in the near future. However, more construction inspectors and water line repairmen should be hired. More inspectors are needed to supervise pipeline installations if an extensive capital improvement program is to be realized. Water line repairmen are urgently needed if any type of leak detection program is to be established. The work done by these men would pay for their employment. If more repair personnel cannot be employed, then consideration should be given to having leak repairs done by contract.

Equipment and supplies include such major items as pipe and meter repair materials, hydrants, office materials, furniture, heating and automotive supplies. Expenditures have increased from about \$300,000 in 1961 to a 1971 appropriation of \$745,000. No allowance was made this year for new automotive equipment, although there is a great need for backhoes, pickup trucks, service vehicles and dump trucks. If this equipment

is not purchased, it will have to be acquired through rental agreements with the cost added to contractual services. For this reason, an allowance of \$150,000 per year has been estimated for the next five years. Other equipment and supply costs are included in the general water service expenditure.

The 1971 appropriations for Contractual Services, and Structures and Improvements are greater than the 1961 appropriations by about \$356,000 and \$589,000, respectively. This is not necessarily indicative of cost increases as more major projects are now being scheduled, as will be discussed under the capital improvement program. However, capital improvements and repairs now under way will be projected with the water service expenditure as it now exists. This is estimated to be \$4,040,000 per year for the next five years. Estimates were made on a straight line basis by projecting costs from 1965 through 1969.

Pensions and Annuities

There are now two types of retirement plans in effect - generally referred to as contributory and non-contributory. The contributory plan has been made mandatory and is part of the Commonwealth retirement program. The non-contributory, or veterans plan, will expire as the last members reach retirement age. The Water Division makes payments to the City Retirement Board for their employees under both plans.

The non-contributory plan has steadily dropped from a high of \$311,000 in 1966 to approximately \$240,000 in 1969. In 1970 a cost of living increase raised this amount to \$263,000. In addition, \$64,000 was contributed toward employees in the Collecting Division, further raising the total to \$327,000. Assuming payments to this plan will continue to decrease at the same rate, an allowance of \$197,000 per year has been made for the next five years.

The contributory plan payments are expected to increase by 7 percent through collective bargaining with an additional increase as new employees replace retiring personnel now on the veterans plan. Accordingly, the projected contributory plan estimate has been adjusted for these new employees. Approximately \$230,000 per year should meet requirements for this plan for the next five years.

Debt and Interest

The General Court of Massachusetts, through Chapter 123 of the Acts of 1952, authorized cities and towns to borrow money for improvements to their water systems. During the last few years the Water Division has found it necessary to finance improvements through the sale of bonds. The existing Water Division indebtedness is shown below:

Type of Loan	Date of Issue	Amount	Percentage Rate	Amount Due Annually	
Water Meter Loan	11/1/66	\$350,000	4.25	\$35,000	1967-76
Water Meter Loan	12/1/67	350,000	4.50	35,000	1968-77
Water Main Loan	12/1/68	300,000	4.75	20,000	1969-83
Water Main Loan	12/1/69	700,000	6.90	50,000	1970-74
				45,000	1975-84
Water Main Loan	12/1/70	1,000,000	5.90	50,000	1971-90

Additional water main loans authorized by the City Council but not yet utilized include one for \$300,000, approved April 17, 1968, and another for \$500,000, approved April 15, 1970. A water main loan of \$750,000 recently requested by the Water Division has yet to be approved by the City Council.

It was assumed that bonds will be issued on the approved loans in 1971 and on the requested loan in 1972. Assumptions also made are that the interest rates will be 5 ¼ percent with a maturity period of 15 years. This would require an average annual expenditure of \$452,500 per year for the next five years for all outstanding indebtedness.

Further debt would accrue if long-term bonds are issued to finance the recommended increase in capital improvement spending. If the proposed \$2,000,000 per year were to be financed at 5 ½ percent for 25 years, the additional debt and interest expenditure would amount to an average of \$552,000 per year and require a total of about \$1 million per year for the next five years.

Capital Improvements

A comprehensive engineering study was made in 1966 of the Boston distribution system by Charles A. Maguire and Associates. Their findings showed major deterioration due to corrosion, which seriously affected flow characteristics throughout the City. A recommended improvement program was proposed for the first five years which was to be part of a long-range program. This includes new construction, cleaning and lining, replacement of mains, enlargement of MDC venturi meters, and experimental field testing for alternate methods of cleaning and lining water mains. The initial five-year program was estimated to cost \$15,600,000 in

September of 1967. Present costs, based on the Engineering News Record cost indices, would be approximately \$21,000,000. Portions of this program have been started. It is not possible to estimate the cost of the long-range program as this is dependent on systematic inspection and pressure testing of feeder mains.

Rehabilitation of smaller mains was estimated to cost \$50,000,000 by the Maguire report, assuming cleaning and lining was required of all small mains in the Boston distribution system. Some of this work is now being done by the Boston Redevelopment Authority (BRA) within urban renewal projects. The BRA is also responsible for City planning, including capital improvements by the Water Division. Preparations are being made for a community renewal program that would schedule Water Division works for one or two year periods.

The 1971 budget provides \$425,000 for cleaning and cement lining water mains, \$400,000 for laying and relaying mains, and about \$70,000 for hydrant changes, including supplies and materials. This annual expenditure of somewhat less than \$1,000,000 per year is inadequate if the Water Division is to keep pace with the required improvements. To complete the initial five-year program recommended by the Maguire report, it would be necessary to allocate \$4,000,000 per year for capital improvements.

Under current conditions for Federal funding, it is doubtful if very much aid will be available. In 1968 a \$900,000 federal grant was given towards construction of two 36-in trunk mains in Dorchester and Charlestown. Most grants go to the BRA for construction in their project areas. Although federal participation should be investigated periodically, the improvement program should not be dependent on government funds.

The problem then, consists of financing improvements and providing engineering and technical supervision. In the area of finance it would not be equitable to impose the full burden of new construction and rehabilitation on today's consumer. However, it is apparent that as improvements are made, the percentage of unbilled water will decrease, providing more revenue and less waste. Accordingly, it is recommended that about half of the proposed annual expenditure of \$4,000,000 for the suggested five-year program be appropriated for the Water Division capital improvement budget. The proposed annual capital expenditure budget, therefore, is \$2,000,000, or twice the present amount. The remaining \$2,000,000 should be borrowed through long-term financing, if available. Assuming 5 ½ percent interest rates, interest and amortization would cost an average of \$590,000 per year if \$2,000,000 is borrowed every year on a continuing basis.

The proposed capital improvement program is too large to be designed and supervised by the existing staff of engineers and inspectors. It is recommended, therefore, that outside assistance be retained to assist in the design, awarding of contracts, and supervision of construction. The Water Division, while planning and scheduling the work of the advisors, would concentrate on maintenance and repair. Cost estimates given include allowances of 20 percent for assistance in the supervision of construction.

Summary of Revenue Requirements

In 1970 the total Water Division costs were about \$12,400,000. These costs are expected to be about \$16,387,000 in 1972 and \$19,373,000 by 1976. A summary of the total annual costs of the Water Division from 1972 to 1976, for which revenue will be required is presented in Exhibit 4.

RECOMMENDED RATE STRUCTURE

General

The billings of the Water Division for 1970 were analyzed by compiling data from magnetic tape records furnished by the Data Processing Unit. A computer program has been prepared by Camp Dresser & McKee for analyzing the metered accounts and projecting revenue. Exhibit 5 presents the data on water used for 1970 for varying ranges of consumption under varying meter sizes, as determined from the computer tape records. A trial program was run on the computer using the data of Exhibit 5 and the present water use charges. The trial produced a revenue of about \$10,520,000. In 1970 the estimated revenue from all sources other than metered rates was \$380,000. This revenue and the water revenue determined by the computer amounts to \$10,900,000. The actual total revenue for 1970 was about \$10,570,000 (Exhibit 1). For the trial program, therefore, actual revenue amounted to about 97 percent of computed revenue.

The results of a study by the Administrative Services Department indicate that total revenue received has amounted to about 98 percent of the amount billed over the past several years.

	Percent of Amount Billed Actually Received			
	1966	1967	1968	1969
Year Bill Rendered	69	65	63	54
Following Year	27	31	33	40
Third Year	2	2	2	-
	98	98	98	94 ¹

This study confirmed that the trial computer program is sufficiently accurate for forecasting purposes. The program assumes that the total number of billed customers will remain relatively constant and that the number of billings for each meter size will correspond to those recorded in 1970. This program was used in determining the water rate schedule necessary to generate the required revenue.

Fire Protection Charges

A special fire protection charge for private fire connections is included in the water rate schedules of most municipalities. These fire protection services provide water for private fire hydrants, automatic sprinkler systems or manually operated outlets, and are

(1) Total at end of second year only

to be used solely for fire extinguishing purposes. For this reason billing rates are generally disproportionate to the cost of installing and maintaining this service. In portions of the City, particularly in the central core, a separate high pressure fire service is provided for fire protection.

Charges should be based on the capital cost of the fire protection system including allowances for depreciation. Such rates, however, would appear to be excessive to those customers who have never had to utilize this service. Some municipalities base their charges on the assessed valuation of the property to be protected, and payment is included in property taxes. City policy here is to charge an annual fee for three size groups. The proposed new rates will reflect the general increase in Water Division expenditures. The estimated total expenses of the Water Division are expected to average about \$18,000,000 per year for the period 1972 through 1976. As this represents an increase of about 100 percent over the total annual expenses during the early 1960s, it is recommended that the present charges for fire service connections be doubled.

In 1970 there were 3,129 fire pipe services 4-in and smaller, 597 6-in services, and 118 services 8-in and larger. It is estimated that there will be a 10 percent increase in the number of fire services in the next 10 years. The following rate schedule for private fire connections is recommended.

Size of Service	Annual Charge for Fire Service Connections	
	Present	Proposed
4-in and smaller	\$50	\$100
6-in	100	200
8-in and larger	200	400

The City should continue its present practice of rendering bills for private fire protection on an annual basis. The annual revenue for the services billed in 1970 at these new rates would be \$479,500 and the estimated revenue for 1976 would be \$528,000. The estimated annual revenue from fire protection charges from 1972 through 1976 is shown in Exhibit 6.

Installation and Repair Charges

The installation of new services and the repair of existing services is at the expense of the customer who pays the full cost of excavation, backfill, paving and any miscellaneous construction costs. A service installation charge which includes the cost of pipe and fittings is made by the Water Division. Current charges are now taken from

a rate schedule prepared by the Water Division in 1966 and based on actual cost. This schedule has been revised and the proposed new rates are shown in Exhibit 7. The connection charges have been raised by 20 percent. This accounts primarily for the increase in material costs with a minor allowance for labor. The charge per foot is based on current pipe prices and handling cost. It is recommended that these rates be reviewed yearly against existing labor and material costs and revised accordingly.

In special circumstances an outside meter is required. This generally is the case where the house is 40 feet or more beyond the property line, where the basement is subject to freezing temperatures, or where the meter cannot be easily read. Meter box or chamber requirements are also shown in Exhibit 7.

Costs for repairs of leaks differ widely and depend to a large degree on how easily the leak is located and the materials required for replacement.

Miscellaneous Charges

There are several services provided by the Water Division for which a nominal charge should be made. These services mainly include shut-off and turn-on requests, meter tests and special meter readings. These are necessary customer services that require a man and vehicle for one or two hours. Many private utilities do not charge for these services as this may produce undesirable customer relations, and account for only a small percentage of revenue. However, to help defray costs a \$5 charge is recommended for all such trips with some exceptions.

In 1969 there were approximately 12,000 water service "off-on" requests. This number of requests has been relatively consistent over the last several years and will probably continue in the immediate future. It would appear logical that the number of turn-on requests balance the number of shut-offs and that most of the same customers require both. Therefore, to reduce accounting work and promote good customer relations it is recommended that a charge be made only for turn-on requests. This would amount to about 6,000 turn-ons or \$30,000 per year. An alternate scheme would be to charge only for new or first time service turn-on requests and shut-offs for vacancies or termination of use.

Special meter readings are made for several reasons. These include sale of property, verification of prior readings, and a check against estimated water use. No charge should be made on readings that require abatements or meter repair.

Another miscellaneous charge includes the use of fire hydrants and water services by construction contractors. Quantity of water and duration of use will vary considerably

among contractors, and charges should be apportioned accordingly. In all cases meters should be installed and the contractor billed at the standard rate for water used. A deposit of \$250 should first be made and a flat connection fee of \$25 charged per quarter, in addition to charges for water actually used at the regular rates. Short term applicants should only pay a \$10 connection fee if they require hydrant rental for 10 days or less. In all cases if the meter is damaged or lost the \$250 deposit should be forfeited.

Estimated revenue from the foregoing miscellaneous charges is shown in Exhibit 8.

Water Use Charges

A minimum charge is applied to each meter size. This provides for a given allowance of water each quarter. When the customer exceeds this allowance, he is billed at a unit rate per 1,000 cubic feet within a rate block schedule. Each meter size has a given minimum water allowance that increases with increasing meter size. The minimum charge for each meter size is the cost of this water allowance at the standard rates. Minimum charges for each meter size are related to the capacity of each meter.

The metered water use charges were determined by using the computer program developed for this purpose with the following input data:

1. Total annual metered water use, 1970, from Exhibit 5.
2. The existing three rate blocks of:
 - 0 - 20,000 cubic feet per quarter
 - 20,000 - 1,000,000 cubic feet per quarter
 - Over 1,000,000 cubic feet per quarter

Various rate schedules were then tried with the criteria that they develop sufficient revenue to meet the required total annual revenue of Exhibit 4 less the annual non-metered water revenue of Exhibit 8. In addition, the theoretical revenue developed should be about 5 percent greater than that required to reflect the fact that less than 100 percent of the amount billed is actually collected.

An additional constraint was that the rate schedule be designed to avoid a deficit in any year up through 1976.

The recommended rate schedule is shown in Exhibit 10. This schedule will provide approximately a 75 percent increase in the revenue generated by the present rate

schedule. The proposed rates would increase the minimum meter charges by 50 percent and increase block water rates by 67 percent.

Exhibit 9 summarizes the expected revenue for the period 1972 through 1976. The meter size designation 0 is a special category for customers such as the Navy yard. These meters register in gallons, but are converted to cubic feet for the computer program. The 3/4-in meter size includes 5/8-in meters and the 4-in meter size includes all meters up to 10 inches. The total number of billings are for the entire year and include both quarterly and semi-annual billings. The increase in revenue for the successive years is derived from the increase in annual per capita consumption applied to the proposed rate increase.

ADDITIONAL RECOMMENDATIONS

In addition to the proposed new water rates, the following recommendations are suggested:

1. A study and report on recommendations for a meter repair program that would include modern shop techniques, manpower and equipment requirements, and capital cost estimates.
2. A leak detection and large meter testing program to be conducted through cooperative efforts of an outside consultant and the maintenance section.
3. A survey by the Water Division of all present locations of unmetered water use, followed by the installation of meters at these locations. These meters could be installed on a contract basis.
4. Design and scheduling of all improvement work about one year in advance with provisions for the following:
 - a. All design drawings to be sent to every utility and concerned agency for their information and acknowledgement.
 - b. The Public Works Department to ensure that the Highway Division inform the Water Division of all streets to be repaved the following year.
5. All water main work in Boston preferably should be the sole responsibility of the Water Division or their appointed advisors. Other agencies (BRA, for example) should not be permitted to do Water Division work.

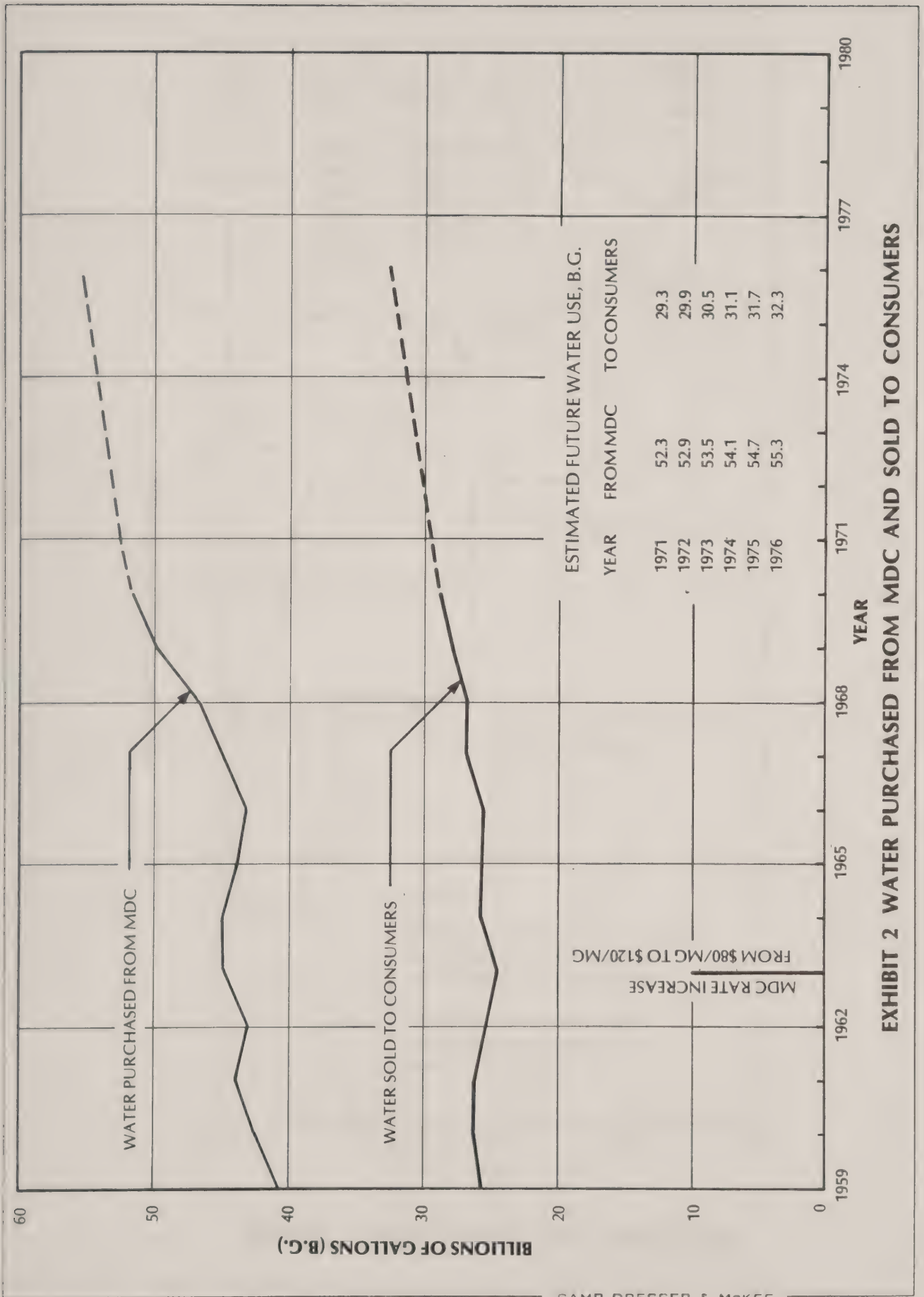
EXHIBIT 1 WATER DIVISION EXPENSES AND REVENUE, 1962-1970

Year	Revenue	Expenditure	Current Charge ¹	City Debt Redemption	Surplus	Deficit
1962	\$9,843,624	\$6,994,578	\$278,232	\$757,666	\$1,813,148 ²	
1963	10,341,516	8,695,771	184,934	1,813,148		\$352,338 ²
1964	10,033,767	9,208,689	245,838		579,241 ²	
1965	10,110,143	9,206,904	277,377	579,241	46,621 ²	
1966	9,657,460	9,106,008	326,096	46,621	178,736 ²	
1967	9,615,894	9,432,130	228,573	178,736		223,545 ²
1968	9,449,999	10,130,002	285,914			965,917 ³
1969	9,208,135	10,817,736	614,004			2,223,605 ³
1970	10,566,282	12,414,016	395,328			2,243,062 ³
			Total	\$3,196,676	Total	\$5,432,584 ³

¹ Charge for contracts not yet paid. Carried forward to next year's appropriation.

² Surplus or deficit carried to following year.

³ Paid by City taxes.



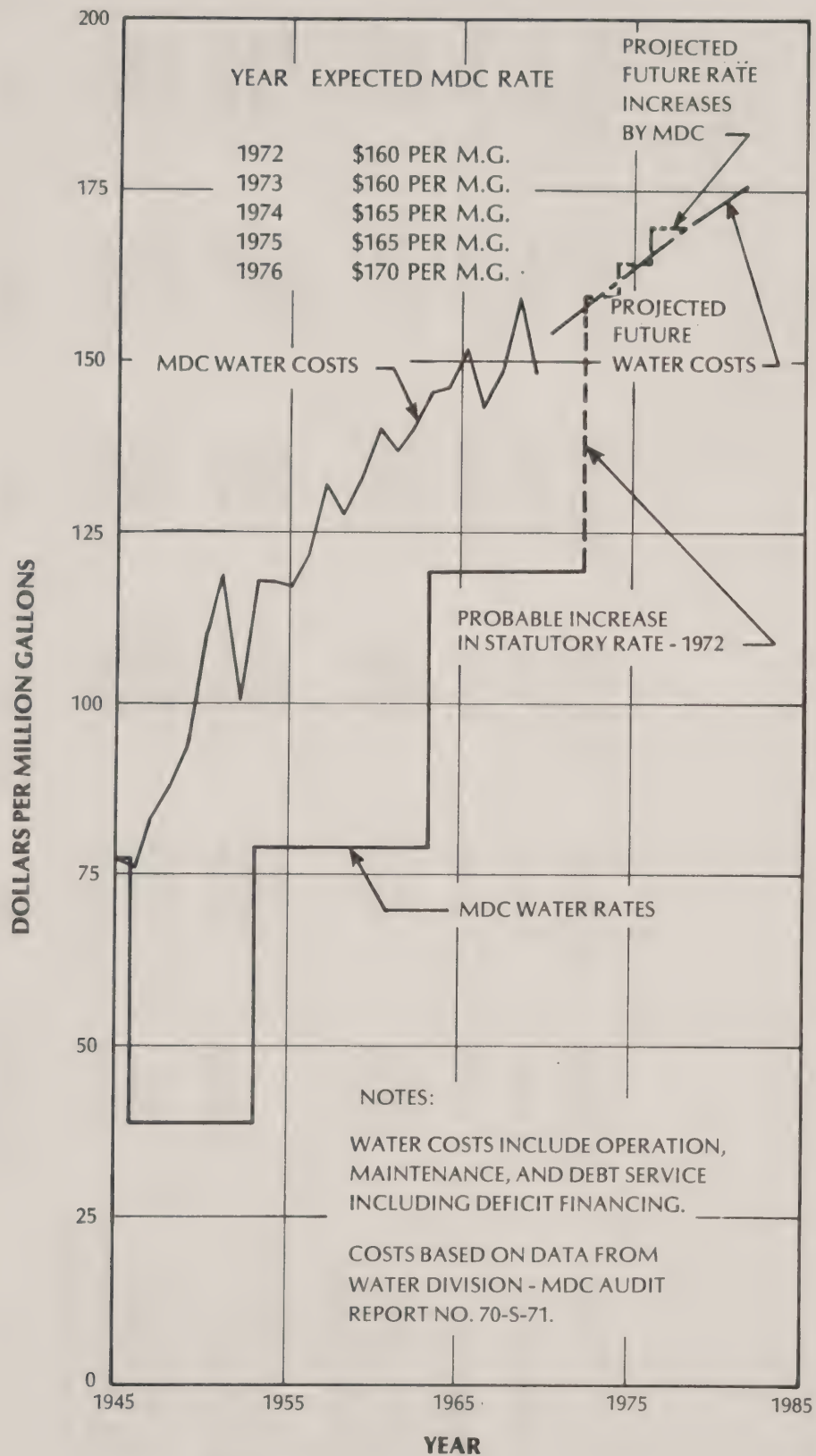


EXHIBIT 3 - MDC WATER COSTS AND RATES

EXHIBIT 4 SUMMARY OF ESTIMATED COSTS, 1972-1976

	Average Costs		Estimated Costs			
	1967-1970	1972	1973	1974	1975	1976
Interdepartmental Charges						
Public Works Department	\$975,000	\$1,180,000	\$1,240,000	\$1,290,000	\$1,360,000	\$1,420,000
Data Processing Unit	335,000	641,000	668,000	697,000	727,000	760,000
Collecting Division	253,000	313,000	336,000	358,000	380,000	401,000
Water Service	3,045,000	3,630,000	3,830,000	4,040,000	4,230,000	4,450,000
Capital Improvements	-	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Automotive Equipment	-	150,000	150,000	150,000	150,000	150,000
Pensions and Annuities						
Contributory	292,000	230,000	213,000	197,000	181,000	164,000
Non-contributory	122,000	176,000	203,000	228,000	258,000	285,000
Debt and Interest	126,000	603,000	864,000	1,030,000	1,186,000	1,342,000
MDC Assessment*	5,552,000	8,464,000	8,560,000	8,927,000	9,026,000	9,401,000
Total	<u>\$10,700,000</u>	<u>\$16,387,000</u>	<u>\$17,064,000</u>	<u>\$17,917,000</u>	<u>\$18,498,000</u>	<u>\$19,373,000</u>

* Estimated MDC costs based on anticipated rate increases.

EXHIBIT 5 BOSTON WATER USE ANALYSES, 1970

Consumption Range ¹		Number of Billings	Total Consumption (cu ft)	Consumption Range ¹		Number of Billings	Total Consumption (cu ft)
Special Category				¾-inch and smaller			
0	20,000	92	451,000	0	1,000	40,864	25,366,000
20,000	1,000,000	63	4,944,000	1,000	1,250	0	0
Over	1,000,000	0	0	1,250	1,500	26,846	40,269,000
				1,500	1,750	0	0
				1,750	2,000	37,103	74,206,000
				2,000	20,000	191,588	979,626,000
				20,000	1,000,000	3,899	145,973,000
				Over	1,000,000	4	150,006,000
1-inch				1½-inch			
0	3,500	1,482	2,543,000	0	5,500	1,371	3,901,000
3,500	3,750	0	0	5,500	6,000	233	1,398,000
3,750	4,000	365	1,460,000	6,000	6,500	16	104,000
4,000	4,250	0	0	6,500	7,000	168	1,176,000
4,250	4,500	46	207,000	7,000	7,500	42	315,000
4,500	20,000	4,965	57,771,000	7,500	20,000	2,977	42,427,000
20,000	1,000,000	2,679	123,414,000	20,000	1,000,000	4,346	235,523,000
Over	1,000,000	0	0	Over	1,000,000	2	3,383,000
2-inch				3-inch			
0	10,000	1,208	6,178,000	0	22,500	1,346	14,326,000
10,000	11,250	54	590,000	22,500	25,000	127	3,099,000
11,250	12,500	92	1,109,000	25,000	27,500	56	1,482,000
12,500	13,750	59	771,000	27,500	30,000	138	4,085,000
13,750	15,000	215	3,172,000	30,000	32,500	46	1,446,000
15,000	20,000	473	8,884,000	32,500	35,000	86	2,967,000
20,000	1,000,000	3,589	285,472,000	35,000	1,000,000	1,813	208,430,000
Over	1,000,000	3	3,185,000	Over	1,000,000	8	16,496,000
4-inch and larger							
0	42,500	1,198	18,480,000				
42,500	45,000	46	2,031,000				
45,000	47,500	21	977,000				
47,500	50,000	167	8,323,000				
50,000	52,500	20	1,030,000				
52,500	55,000	27	1,464,000				
55,000	1,000,000	2,555	647,070,000				
Over	1,000,000	264	702,750,000				

¹ Consumption ranges are in cubic feet per quarter.

EXHIBIT 6 ESTIMATED ANNUAL REVENUE FROM FIRE PROTECTION CHARGES

Size of Service	Annual Charge	1972		1973		1974		1975		1976	
		Services	Revenue	Services	Revenue	Services	Revenue	Services	Revenue	Services	Revenue
4-in and smaller	\$100	3,223	\$322,300	3,277	\$327,700	3,331	\$333,100	3,386	\$338,600	3,443	\$344,300
6-in	200	617	123,400	627	125,400	638	127,600	648	129,600	659	131,800
8-in and larger	400	122	48,800	124	49,600	126	50,400	128	51,200	130	52,000
Total		3,972	\$494,500	4,028	\$502,700	4,095	\$511,100	4,162	\$519,400	4,232	\$528,100

**EXHIBIT 7 CHARGES FOR INSTALLATION OF DOMESTIC
AND FIRE SERVICE CONNECTIONS**

Connection Size (in)	Connection Charge	Charge Per Foot of Service Pipe
$\frac{3}{4}$	\$60	\$0.75
1	66	1.00
1½	100	2.00
2	132	3.50
4	480	5.00
6	540	8.00
8	540	11.00

Where Outside Meter is Required

$\frac{3}{4}$ -in to 2-in	\$50 plus service connecting charge. Meter box and cover furnished by City.
4-in to 8-in	Applicant is required to build a brick or concrete block chamber.

THE UNIVERSITY OF CHICAGO
DEPARTMENT OF CHEMISTRY
RESEARCH REPORT

1. Introduction
2. Experimental
3. Results
4. Discussion
5. Conclusion

Author: [Name]
Date: [Date]
Title: [Title]

EXHIBIT 8 SUMMARY OF NON-METERED WATER REVENUE

Source of Revenue	1972	1973	1974	1975	1976
Fire Protection	\$494,500	\$502,700	\$511,100	\$519,400	\$528,100
Installation and Repairs	37,600	38,200	38,800	39,400	40,000
Miscellaneous Charges	36,400	37,000	37,600	38,300	39,500
Total	<u>\$568,500</u>	<u>\$577,900</u>	<u>\$587,500</u>	<u>\$597,100</u>	<u>\$607,600</u>

EXHIBIT 9 ESTIMATED REVENUE, 1972-1976

ESTIMATED REVENUE 1972

METER SIZE	NUMBER OF BILLINGS	QUANTITY BILLED	REVENUE PROPOSED	PER CENT OF TOTAL REVENUE
0	165	5592781	24485.17	0.13
5/8 & 3/4	327150	1509081347	7340472.01	40.86
1	9537	192191584	908641.50	5.05
1-1/2	9388	300242624	1372944.00	7.64
2	5785	321851776	1441962.25	8.02
3	3747	264794016	1209139.75	6.73
4 AND LARGER	5496	1451950851	5665475.01	31.53

ESTIMATED METERED REVENUE 17963116.04

ESTIMATED NON-METERED REVENUE 569000.12

TOTAL ESTIMATED REVENUE 18532116.05

ESTIMATED REVENUE 1973

METER SIZE	NUMBER OF BILLINGS	QUANTITY BILLED	REVENUE PROPOSED	PER CENT OF TOTAL REVENUE
0	165	5691671	24898.06	0.13
5/8 & 3/4	327150	1535764483	7459966.01	40.87
1	9537	195589856	923363.75	5.05
1-1/2	9388	305551488	1395095.50	7.64
2	5785	327542720	1464945.75	8.02
3	3747	269476032	1226875.75	6.72
4 AND LARGER	5496	1477624067	5755177.01	31.53

ESTIMATED METERED REVENUE 18250316.04

ESTIMATED NON-METERED REVENUE 578000.12

TOTAL ESTIMATED REVENUE 18828316.04

EXHIBIT 9 (Continued)

ESTIMATED REVENUE 1974				
METER SIZE	NUMBER OF BILLINGS	QUANTITY BILLED	REVENUE PROPOSED	PER CENT CF TOTAL REVENUE
0	165	5790022	25308.69	0.13
5/8 & 3/4	327150	1562302211	7578807.01	40.88
1	9537	198969632	938006.00	5.06
1-1/2	9388	310831296	1417126.25	7.64
2	5785	333202560	1487806.00	8.02
3	3747	274132544	1244514.75	6.71
4 AND LARGER	5496	1503156995	5844389.01	31.53
ESTIMATED METERED REVENUE			18535952.04	
ESTIMATED NON-METERED REVENUE			588000.12	
TOTAL ESTIMATED REVENUE			19123952.04	
ESTIMATED REVENUE 1975				
METER SIZE	NUMBER OF BILLINGS	QUANTITY BILLED	REVENUE PROPOSED	PER CENT CF TOTAL REVENUE
0	165	5889452	25723.84	0.13
5/8 & 3/4	327150	1589131267	7698952.01	40.89
1	9537	202386432	952808.62	5.06
1-1/2	9388	316169089	1439398.50	7.64
2	5785	338924544	1510913.00	8.02
3	3747	278840128	1262347.75	6.70
4 AND LARGER	5496	1528970243	5934579.01	31.52
ESTIMATED METERED REVENUE			18824720.04	
ESTIMATED NON-METERED REVENUE			597000.12	
TOTAL ESTIMATED REVENUE			19421720.04	

ESTIMATED REVENUE 1976

METER SIZE	NUMBER OF BILLINGS	QUANTITY BILLED	REVENUE PROPOSED	PER CENT CF TOTAL REVENUE
0	165	5988342	26136.73	0.13
5/8 & 3/4	327150	1615814403	7818445.01	40.90
1	9537	205784704	967531.00	5.06
1-1/2	9388	321477952	1461550.00	7.64
2	5785	344615488	1533897.00	8.02
3	3747	283522176	1280083.50	6.69
4 AND LARGER	5496	1554643203	6024280.01	31.52

ESTIMATED METERED REVENUE

19111916.05

ESTIMATED NON-METERED REVENUE

608000.12

TOTAL ESTIMATED REVENUE

19719916.04

EXHIBIT 10 SCHEDULE OF RECOMMENDED METERED WATER RATES

Quantity	Existing Quarterly Water Rates		Recommended Quarterly Water Rates	
	Minimum Charge	Water Allowance (cu ft)	Minimum Charge	Water Allowance (cu ft)
First 20,000 cu ft	\$5.00	1,666	\$5.00 per 1000 cu ft	1,500
Next 980,000 cu ft	12.50	4,166	4.10 per 1000 cu ft	3,750
Over 1,000,000 cu ft	18.75	6,250	3.00 per 1000 cu ft	5,600
	37.50	12,833		11,250
	75.00	26,000		23,048
	125.00	46,000		41,341

